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ABSTRACT

This curriculum guide was developed for use with public television's Nature series. The materials in the guide are designed to help students actively participate in the study and experience of nature. Students are encouraged to view the programs as a scientist would, observing natural phenomena and drawing conclusions. Each lesson in the Teacher's Resource Guide includes: (1) a "Program Overview" that presents background information and brief synopses of the program to be viewed; (2) "Objectives" that provide the teacher with measurement goals; (3) a "Before Viewing Activity" that familiarizes students with the subject and allows them to set purposes for viewing; (4) "Vocabulary" that features definitions of unfamiliar words used in each program; (5) "Discussion Questions" that help students assess the main points of the program; (6) "Suggested Reading" for students who may want to learn more about the topic; and (7) a "Naturalist's Guide" (student worksheet) to be duplicated and distributed to students. The programs highlighted in this guide focus on the powerful natural forces that change the earth and how these forces affect the vast variety of life forms covering the planet. Program titles include "In the Beginning," "Perpetual Motion," "Heavenly Partners," "Living Dangerously," and "Playing with Fire." (WRM)

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NATURE™

FORCES OF THE WILD

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PARK FOUNDATION

Dear Friends of NATURE:

Park Foundation has a special interest in the environment as well as in education. That is why we are delighted to sponsor NATURE, the series that offers educators an opportunity to bring young people to the most remote and beautiful places on earth. This year's education package offers lessons, activities, and research projects to accompany the NATURE miniseries Forces of the Wild. Our goal is to help you enrich your students' appreciation and understanding of this important series about the elemental forces that shape our planet.

We hope you find these materials useful in your efforts to introduce young people to the power and beauty of the natural world. Please know we are grateful for your work and are pleased to help support it.

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Dear Educator:

For the eighth consecutive year Canon U.S.A., Inc. is pleased to be a sponsor of the NATURE series, and bring you this Teacher's Guide.

NATURE brings the wonders of the natural world into our homes in a unique and informative manner. The NATURE miniseries featured in this guide -- Forces of the Wild -- will give you and your students new insights into powerful forces of nature and the ways that they affect life on Earth.

At Canon, we hold the environment in high regard. By teaching students about the natural world, we feel they will develop an appreciation of our world and will be better able to protect it in the years to come.

We trust that this Teacher's Guide will provide you with some tools to enhance your teaching of the world around us.

We salute your efforts and wish you all the best in preparing our children to better understand our global environment and the people who make up our world.

Sincerely,

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Alex Trotman
Chairman of the Board

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Ford Motor Company
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Dear Educator:

For the fourth consecutive year, the men and women of Ford Motor Company are proud to bring you this Teacher's Guide for the NATUFE series.

This educational series, with its emphasis on wildlife, its habitats and their preservation, as well as the concerns of naturalists, parallels our efforts to protect the environment and be a responsible automotive company. Our employees have a vision to provide more people in more places with products that will not only raise our standard of living, but will also raise the banner of environmental stewardship.

This year's Guide features the five-part series, Forces of the Wild. The Guide will help young people become more aware of the origins of our planet; the powerful geological, atmospheric, and gravitational forces that shape the world and affect different creatures; and the ways people are changing the ecosystem by harnessing the forces of nature.

Ford and the more than 350,000 employees who comprise its global team hope you find these materials useful in making the most of NATURE and increasing the environmental awareness of our youth.

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Alex Trotman

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TIAA CREF

John H. Biggs,
Chairman, President and CEO

Dear Educator,

TIAA-CREF is delighted to be a national sponsor of NATURE, and to help bring its valuable learning insights and teaching materials to you and your students.

We hope you find this Teacher's Guide useful as you and your students study NATURE's exciting five-part series, Forces of the Wild.

For over eighty years, TIAA-CREF has recognized the crucial role of the teacher in our society. We are dedicated to providing pension, investment, and insurance products that help build financial security for those who choose careers in education and research.

TIAA-CREF salutes you and your colleagues for your commitment to educating our youth.

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John H. Biggs

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INTRODUCTION

This Teacher's Guide has been developed for use with public television's NATURE series. This guide focuses on the NATURE miniseries, Forces of the Wild. The episodes in this miniseries show that powerful natural forces are always changing the earth, and that these forces affect the vast variety of life-forms covering the planet. Forces of the Wild discusses the efforts of scientists to understand these forces, and also shows that there is much that remains to be learned.

The Educational Materials

This guide has been designed to help teachers and students use the public television series as a starting point for active participation in the study of nature. Students are encouraged to view the programs as a scientist would, observing natural phenomena and drawing conclusions.

Each lesson in this Teacher's Guide includes:

✔ a Program Overview, which gives background information and a brief synopsis of the program to be viewed

✔ Objectives, which provide the teacher with measurable goals

✔ a Before Viewing Activity, familiarizing students with the subject and allowing them to set purposes for viewing

✔ Vocabulary, which provides definitions of unfamiliar words used in each program

✔ Discussion Questions that help students assess the main points of the program

✔ Suggested Resources for students who may want to learn more about the topic; and

✔ a Student Worksheet (Naturalist's Guide), to be duplicated and distributed to students. This student worksheet contains activities that encourage students to gain a better understanding of animal behavior, earth science, and other subjects discussed in Forces of the Wild. The student worksheets encourage family viewing and include cooperative learning activities.

Creating a Naturalist's Diary

Naturalists keep diaries to record their observations. In order to complete activities presented in this guide, students may be interested in making diaries of their own. Students may set aside part of their science notebook, or they may choose to make a separate booklet for this purpose. Diaries may include news clippings, drawings, photos, maps, charts, graphs, and other information, as well as records of observations. Students may wish to share their diaries with others or use their entries to develop a bulletin board display that reflects what they have learned.

Program Scheduling

Programs are scheduled to be broadcast on the dates indicated below. Broadcast dates, however, may vary slightly from area to area. Please check local listings for any scheduling changes.

Program Broadcast Dates

"In the Beginning" ..... April 26
"Perpetual Motion" ..... April 27
"Heavenly Partners" ..... April 27
"Living Dangerously" ..... April 27
"Playing with Fire" ..... May 3

Web sites

Look for more information about NATURE on the Web at **www.pbs.org** or at **www.wnet.org.** These and related lessons can be found on **wNetSchool** (www.wnet.org/wnetschool).

Videotaping Rights

You may assign programs to your students for viewing when they are first broadcast, or you have the right to tape the programs and play them for instructional purposes for one year after the original broadcast.

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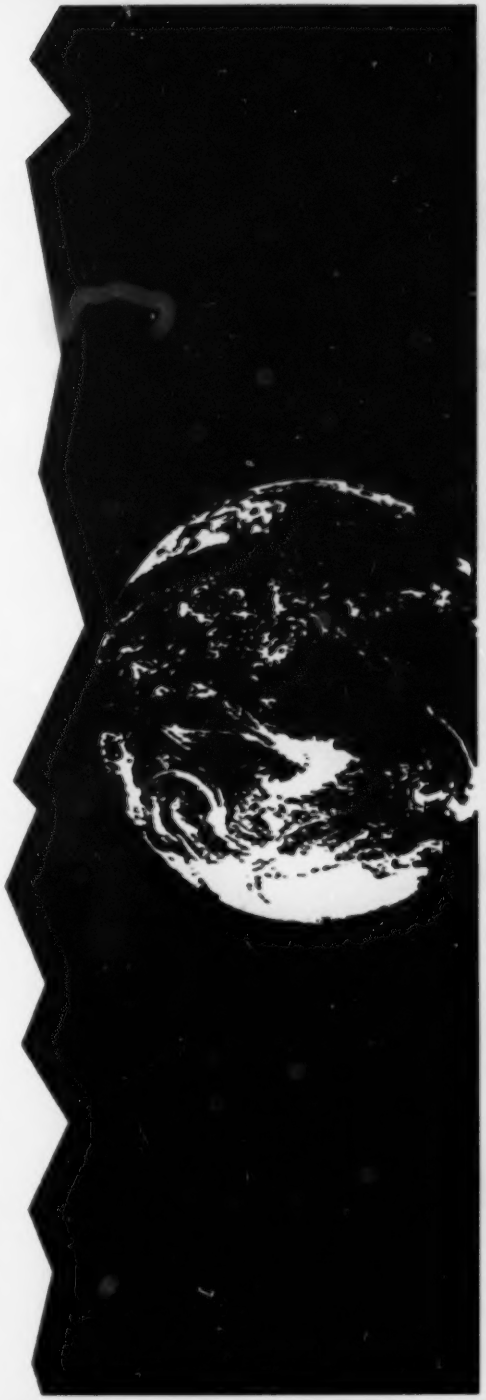

OBJECTIVES

Students will:

✔ examine and analyze how the dynamic interaction between extreme temperatures influences the earth's development

VOCABULARY

You may wish to introduce students to the vocabulary before viewing the program.

aurora borealis noun: also known as the "northern lights"; brightly colored lights that appear in the atmosphere above the north geomagnetic pole; caused by electrically charged particles from the sun slamming into the upper fringes of our atmosphere. The particles are guided down by Earth's magnetic field

DNA noun: (deoxyribonucleic acid) the microscopic building block of life; a double helix-shaped molecule located in the nuclei of many cells that is able to make replicas of itself

magnetic field noun: the area surrounding a magnetic body; some migrating birds may use Earth's magnetic field to help them navigate

photosynthesis noun: a chemical process by which green plants make their food. Plants use energy from the sun to turn water and carbon dioxide into food, and give off oxygen as a by-product

SUGGESTED RESOURCES

For students who want to learn more about this topic, suggest the following:

Books

Caduto, Michael, and Joseph Bruchac. Keepers of the Earth: Native American Stories and Environmental Activities for Children. Golden, Colo.: Fulcrum Press, 1997.

Sattler, Helen Roney and Maestro, Giulio. Our Patchwork Planet: The Story of Plate Tectonics. New York: Lothrop Lee & Shepard, 1995.

Internet sites

Earth
http://seds.lpi.arizona.edu/nineplanets/nineplanets/earth.html

Cool Links in Earth Science
http://geosun.sjsu.edu/~susan/links.html

Vatnajökull Iceland Eruption
http://www.norvol.hi.is/hardy.html

PROGRAM OVERVIEW

For countless years, humans have wondered about the origins of the earth and the solar system. Ancient myths describe how our planet was created between lands of fire and ice. Modern scientists are dazzled by the profound influence of extreme temperatures on the development of the earth.

Using a combination of computer animation and video images of natural phenomena, "In the Beginning" describes the origin of the solar system. Scientists believe that the sun was created billions of years ago, as a result of a massive nuclear explosion triggered by a gigantic dust cloud collapsing in on itself. Remains of the dust cloud condensed into lumps, joined together, and formed planets.

Earth began as a lifeless place without any atmosphere. When radioactive rocks started to decay, and meteors hit Earth's surface, the planet gradually heated up. The entire planet eventually melted and its layers reorganized – the heavy elements moved toward the center, and the lighter elements relocated to the top. After Earth cooled, volcanoes heated the planet again and eventually created temperatures at which liquid water could exist. Liquid water is essential for life on Earth.

This program offers fascinating perspectives of our planet – ranging from distant images in outer space to underwater photography three miles below the ocean's surface. Special attention is devoted to Iceland, where volcanic eruptions under glaciers have caused severe damage.

THEME: "In the Beginning" demonstrates how the interaction of extreme temperatures influences the development of our planet.

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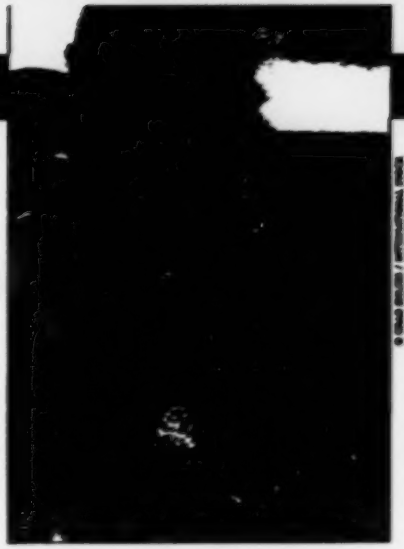

BEFORE VIEWING THE PROGRAM

Introducing the Program

"In the Beginning" states that the reorganizing of Earth's elements (billions of years ago) was a major event in Earth's history. To help students understand Earth's formation, present the following demonstration. Fill a jar with water and soil of various types of sediment (pebbles, clay, silt, and humus). Discuss the make-up of the soil with students and ask them to predict which type of sediment will settle first after the jar is shaken. Then, shake the jar and watch the soil separate. The denser material will sink and the lighter will rise to the top. Compare this to the layers of Earth – organized with the heavier elements at the center and the lighter elements at the top.

Distribute the Student Worksheet (Naturalist's Guide)

Duplicate and distribute the Student Worksheet (Naturalist's Guide – opposite page) to students and preview it with them. As they watch the program, encourage students to observe the various ways that extreme temperatures formed and re-formed the earth. In addition, ask them to pay close attention to the creatures that exist in these environments.

AFTER VIEWING THE PROGRAM

Encourage students to discuss the program and share their observations. The following questions may be used to spark discussion.

1. **How did Earth's distance from the sun affect the appearance of life on our planet?** (Its distance made it possible for the outer part of the earth – the crust – to cool. On the other hand, Earth's proximity to the sun kept the earth's core warm, which eventually enabled volcanic eruptions to warm the planet and form an atmosphere that supported water. Soon afterward, life began on Earth.)

2. **When scientists explored the Atlantic Ridge, three miles below the surface, what surprises did they find?** (In addition to underground volcanoes called "black smokers," the scientists found unusual creatures – bacteria, shrimp, and tube worms – that get their energy from minerals found below the ocean floor.)

3. **Why is Iceland sometimes called "the land of ice and fire"?** (Although parts of Iceland are covered with glaciers, Iceland is also the most volcanic place on Earth. Iceland has many volcanoes because it is located on top of the mantle plates that separate Europe and North America. When these plates gradually pull apart, volcanoes erupt.)

4. **What causes the earth's magnetic field? How do birds, such as barnacle geese, use this magnetic field to help them navigate over great distances?** (The earth's magnetic field is caused by the slow, circular movement of molten iron at the earth's core. In good weather, geese will use the position of the sun to navigate. According to "In the Beginning," these birds may also use a mental "picture" of the magnetic field to travel thousands of miles from their nesting ground to their wintering ground.)

Complete the first activity and one other activity of your choice.

When You're Hot, You're Hot

As you view the program, you will see many examples of how the surface of the earth continues to change. Take notes about the different examples of "fire" and "ice" that you notice. Compare the ways that these extreme temperatures affect the environment and the creatures that live in each location. Discuss your observations with your class.

LOCATION	EXAMPLES OF "FIRE" (volcanoes, geysers, steam)	EXAMPLES OF "ICE" (snow, ice, glaciers)	ANIMALS THAT LIVE THERE (bacteria, geese, tube worms)
YELLOWSTONE NATIONAL PARK			
ATLANTIC RIDGE			
ICELAND			

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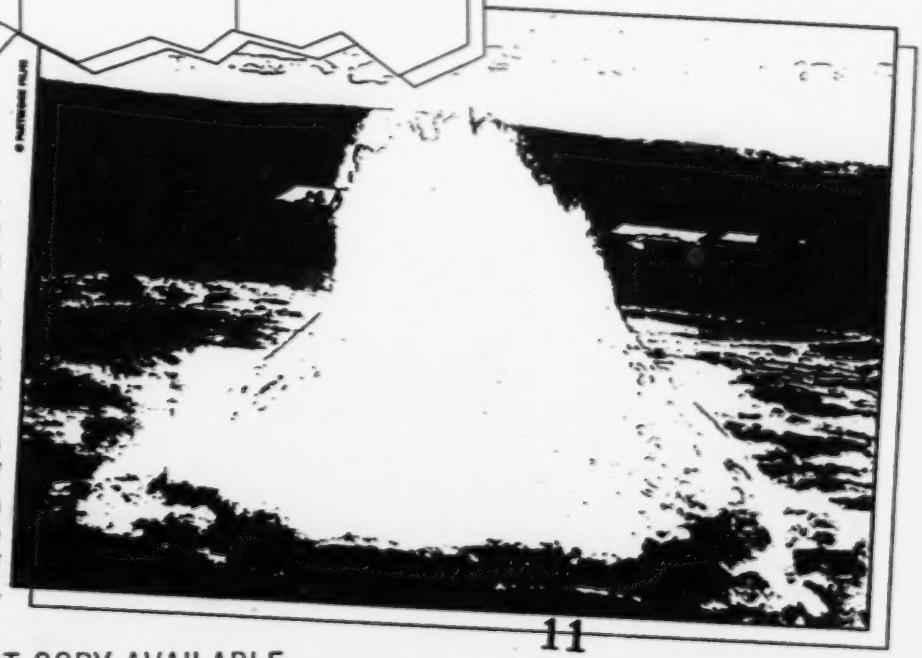
Work with two or three other students to create your own dramatic myth/legend about how the earth was created, using the elements of fire and ice. Tell the story of your myth on a mural, using a combination of words and images.

These materials were made possible by Park Foundation, Canon U.S.A., Inc., Ford Motor Company, and TIAA-CREF.

To The Family

You are invited to view NATURE. As you watch the program, look for answers, both scientific and in legends, to questions such as, "What causes volcanoes?" After the program, share your observations with your family.

In October, 1996, Iceland experienced a natural disaster when a volcano erupted below the Vatnajökull glacier, causing the ice to melt and flood nearby towns. Using resources from your library, create an interesting presentation for your class about this dynamic event or other volcanoes of interest. Find out what geologists had to say about this event. How did people work together to save lives and try to protect property? What steps, if any, have been taken to protect the towns in the future? Create a short book that tells the story of this event – or what might happen if a volcano erupted near your home town – and share it with your class.



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OBJECTIVES

Students will:

✓ understand some ways in which the forces of wind and water shape the earth

✓ describe the environmental conditions that create tropical rainforests and deserts

VOCABULARY

You may wish to introduce students to the vocabulary before viewing the program.

air mass noun: a body of air that extends for hundreds or thousands of miles horizontally and maintains a consistent temperature and level of humidity

currents noun: large quantities of air or water that usually flow in the same direction

doldrums noun: the part of the ocean nearest to the equator that experiences almost no wind

jet stream noun: a long, narrow air current of high-speed winds located in the atmosphere above the clouds; used by some airplanes to speed up their journey

monsoon noun: strong, seasonal winds, especially in the Indian Ocean and Southeast Asia; a season of very heavy rainfall

oasis noun: a fertile or green area located in an otherwise dry climate; caused by underground springs

trade winds noun: winds that blow toward the equator from the northeast; used by navigators traveling from Europe to North America

SUGGESTED RESOURCES

For students who want to learn more about this topic, suggest the following:

Books

Bruchac, Joseph. Between Earth and Sky: Legends of Native American Sacred Places. San Diego: Harcourt Brace and Company, 1996.

Kane, Herb Kawainui. Pele: Goddess of Hawai'i's Volcanoes. Captain Cook, Hawai'i: Kawainui Press, 1996.

Lantier-Sampon, Patricia. Hurricane!: The Rage of Hurricane Andrew. Milwaukee: Gareth Stevens, 1993.

Internet sites

Weather Online – Tropic Storms
http://weatheronline.com/tropindex.html

Hurricane & Storm Tracking – Atlantic & Pacific Oceans http://hurricane.terrapin.com

PROGRAM OVERVIEW

People usually think about the impact of wind and water only when these forces create havoc, such as hurricanes or tornadoes. In reality, these two forces are in continuous motion and constantly shape our planet.

The combination of water, wind, and heat provides the necessary conditions for tropical rain forests. Warm, moist air rises above the tropics and dumps huge quantities of rain on the land around the equator. The ground of the Amazon rain forest is often flooded under ten feet of water. Some people still regard rain as a powerful spiritual being. The Totonac Indians of Mesoamerica, for example, perform daring rituals to appease their rain god, Tlalloc.

The same air masses that create rain forests also produce deserts around the world, such as the Sahara in North Africa. Desert creatures, such as camels, have evolved special features to survive in such harsh conditions.

When moist air masses return to the equator, they create trade winds that help birds and humans navigate eastward across the Atlantic. In the Pacific, these winds create massive quantities of rain as they hit the chain of Hawaiian islands. Winds blowing over the ocean also create currents, such as the Gulf Stream.

"Perpetual Motion" follows Hurricane Andrew as it destroys thousands of homes in southern Florida in 1992. Despite the ruin, hurricanes perform an important ecological role. They act as safety valves for the planet by releasing the earth's build-up of energy.

THEME: The continuous circulation of wind and water disperses the sun's heat around the earth and affects life in diverse regions, from rain forests to deserts.

BEFORE VIEWING THE PROGRAM

Introducing the Program

Discuss with students some of the ways that tropical storms have affected people in America. Then, use a globe or map to help your students find the locations of various habitats on Earth that are affected by the forces of wind and water. Where are the earth's tropical rain forests located? (Close to the equator.) Why? (As tropical hot air masses rise, large quantities of moisture rise from the ocean, condense, then fall as rain.) Where are many of the earth's deserts located? (In the areas north and south of the equator.) Why? (Hot, dry air masses remove the moisture from the land.) If time permits, invite students to discuss recent hurricanes, tornadoes, or monsoons in the news. In what ways did these storms affect people living in their paths?

Distribute the Student Worksheet (Naturalist's Guide)

Duplicate and distribute the Student Worksheet (Naturalist's Guide – opposite page) to students and preview it with them. As students watch the program, encourage them to look for the different ways that wind and water currents affect weather and wildlife. In particular, ask students to pay special attention to how deserts are formed, and to the various plants and animals that survive there.

AFTER VIEWING THE PROGRAM

Encourage students to discuss the program and share their observations. The following questions may be used to spark discussion.

1. **How have the Midway Islands in the Hawaii Chain changed over time? How will they change in the future?** (The Midway Islands, like all islands on the Hawaiian Ridge, began as active volcanoes that grew bigger as they spewed lava, which then hardened. As these islands were exposed to wind and water, they became home to various plants and animals. In the future the elements will wear away the Midway Islands, until they eventually sink below the ocean surface and join the rest of the "hidden island chain.")

2. **How did English explorer John Cabot discover the existence of the Gulf Stream in the Atlantic Ocean?** (John Cabot's crew kept their beer in the lower part of the ship to keep it cold and fresh during the long journey. When their ship headed south on the Atlantic, they were surprised to discover that the beer had turned sour. They realized they had discovered a warm undercurrent – the Gulf Stream waters – that would eventually help them navigate more efficiently between England and North America.)

3. **How does sargassum seaweed help support an ecosystem? Why do many sea creatures live among these plants?** (Sargassum seaweed is the world's only migratory plant. It drifts and circulates on the warm Gulf Stream currents of the Atlantic. A number of sea creatures – toad fish, sea slugs, crabs – live in sargassum since the plants are one of the few places to hide in the open sea. The animals and plants function as a community within the marine environment.)

Complete the first activity and one other activity of your choice.

The Great Deserts

Many people think of the world's deserts as a collection of lifeless sand dunes. It's true that deserts lack the rich variety of plants and animals found in the moist rain forests. Nevertheless, deserts are home to some vibrant wildlife. As you watch the program, use this chart to take notes on the different deserts you see. You will probably need to use library resources to help you complete your research.

DESERT	LOCATION	ANIMALS	PLANTS	OBSERVATIONS
SAHARA	North Africa	camels	palms	over 3,000 miles wide
DEATH VALLEY				
MOJAVE				
GOBI				
KALAHARI				

Today The World By Storm

This program describes hurricanes as "the most powerful force on the planet." The video of Hurricane Andrew shows how this storm destroyed many homes in southern Florida. Use library resources to research a recent tropical storm or hurricane. Find out where the storm started, how it developed, and how it affected the lives of the nearby populations. If possible, find out methods used by scientists to predict the path of the storm. (If you have access to the Web, you may want to view http://weatheronline.com/trop index.html) Present your findings to your class.

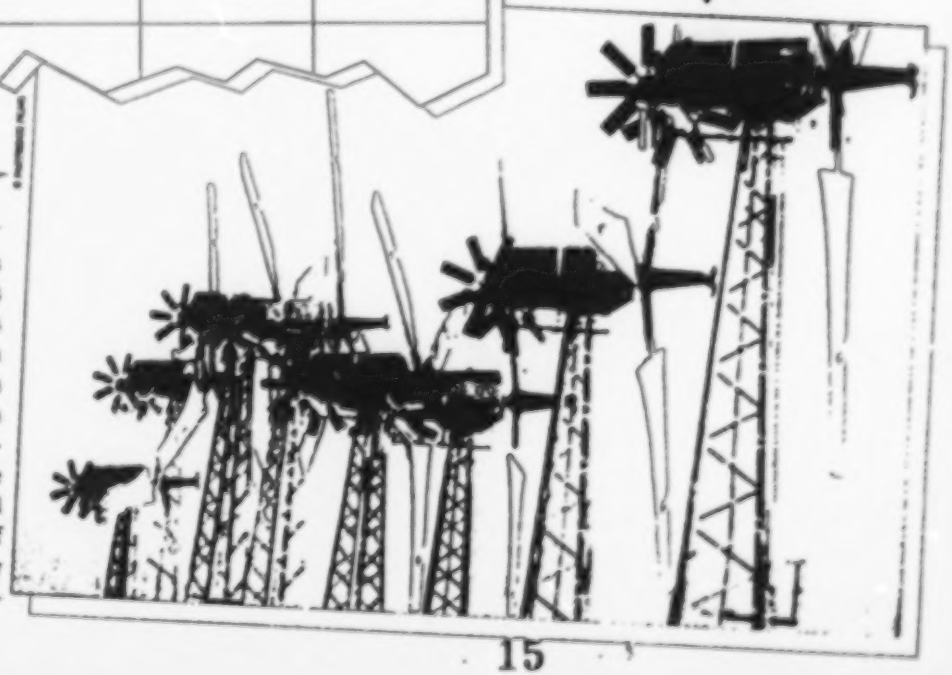
These materials were made possible by Park Foundation, Canon U.S.A., Inc., Ford Motor Company, and TIAA-CREF.

Blowing In The Wind

In this program, you'll see hundreds of windmills spinning on the hillsides of California. The narrator mentions that the gentle winds in this region provide enough energy to power an entire city. Find out how people turn the force of the winds into electricity. Find an article, book, or Web site that tells the story behind a "wind factory." As an extra challenge, see if you can figure out approximately how many windmills would be needed to power your city or town.

To The Family

You are invited to view NATURE. As you watch the program, look for the different ways that air and water currents affect weather and wildlife. After the program, discuss these observations with your family.



OBJECTIVES

Students will:

✔ observe and analyze how the sun and moon control the seasons and tides on earth

✔ examine the ways in which animal behavior is influenced by rhythms caused by the sun and moon

VOCABULARY

You may wish to introduce students to the vocabulary before viewing the program.

axis noun: a straight line about which the earth rotates

equinox noun: one of the two days a year (in spring and in autumn) when day and night are exactly the same length all over the world

gravity noun: the attraction of the mass of the earth, sun, and moon

solstice noun: either of two times a year (in June and in December) when the earth is the farthest from the sun; the longest and shortest nights of the year

Stonehenge noun: collection of monoliths in England built by prehistoric people

tides noun: the alternate rising and falling of the surface of the ocean, caused by the gravitational pull of the moon and sun

SUGGESTED RESOURCES

For students who want to learn more about this topic, suggest the following:

Books

Allison, Linda. The Reason for Seasons: The Great Cosmic Megagalactic Trip Without Moving from Your Chair. Boston: Little, Brown, 1975.

Forsyth, Adrian and Laurel Aziz. Exploring the World of Birds: An Equinox Guide to Avian Life. Camden East, Ontario: Camden House Pub, 1990.

Lyon, Nancy. The Mystery of Stonehenge. Austin, Tex: Raintree Steck-Vaughn, 1997

Internet sites

Live Weather Images
http://www.weatherimages.org

Worldtime Interactive Atlas
http://www.worldtime.com/cgi-bin/user/hb1005/wt.cgi

Phenology - a diary of nature related facts
(created by a 6th grade science class)
http://www.metro2.k12.mn.us/~WMpms/phenology.html

PROGRAM OVERVIEW

The sun, moon, and Earth create the rhythms of life. The moon's gravitational pull on the earth produces the oceans' tides. Many creatures are influenced by these tides. Tiny green worms in England, for example, only emerge from the sand during low tide.

As the earth spins on its axis, day and night are created. During the summer time, the sun's rays hit our part of the northern hemisphere directly as a result of the earth's tilt, causing warm weather. During the winter time, the rays hit the earth at a different slant, causing colder weather.

"Heavenly Partners" illustrates how the tides and seasons affect different creatures. For example, the spring tides in Delaware Bay are a signal for thousands of horseshoe crabs to crawl onto the beaches to spawn.

This program discusses how ancient civilizations recorded and celebrated the changing seasons, and presents the ancient ruins of Chichén Itzá in Mexico. People today still celebrate key turning points of the year. Christmas celebrations have their origins in a festival honoring the midwinter solstice, the longest night of the year.

This program presents fascinating footage of Stonehenge on Midsummer Day, as the sun rises directly behind one of the ancient monoliths. Also featured are glorious shots of the fall foliage in New England.

THEME: The sun and moon create the seasons and tides on Earth and have a profound influence on behaviors of various creatures.

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BEFORE VIEWING THE PROGRAM

Introducing the Program

The amount of daylight in a given city on a particular day depends on the time of year and the location on Earth.

Ask your students to use a globe to pick four cities and then, as a class, use library resources to figure out how many hours of daylight each city currently receives daily.

If you have access to the Internet, you can help students explore these facts by using a globe and the Web site called "Live Weather Images" (see Suggested Resources). Explain the four key times of the seasons. First, describe the vernal equinox and autumnal equinox, the two times when the amount of daylight is equal to the amount of darkness – 12 hours each. Next, explain the summer solstice and the winter solstice, the times when the days are longest and shortest, respectively. Inform your students that near the equator, the amount of daylight is fairly consistent – usually 12 hours every day. In contrast, near the poles, the amount of sunlight varies widely, ranging from complete darkness to 24 hours of uninterrupted sunshine.

Distribute the Student Worksheet (Naturalist's Guide)

Duplicate and distribute the Student Worksheet (Naturalist's Guide – opposite page) to students and preview it with them. As they watch the program, encourage students to make observations about the seasons. In particular, what happens to various creatures during the different seasons?

AFTER VIEWING THE PROGRAM

Encourage students to discuss the program and share their observations. The following questions may be used to spark discussion.

1. **How does the change in seasons affect the wildebeest in Africa?** (Each year, over a million wildebeest migrate across the dry regions of Africa in search of their primary food source, fresh grass.)

2. **At Midsummer Day, if you were looking up at the sky at the Arctic Circle, describe how the sun's movement would appear across the sky.** (The sun moves across the sky, very close to the horizon. On Midsummer Day, the sun never sets.)

3. **On the island of Herm in the Channel Islands, green flatworms come out of the ground when the tide goes out. When the tide returns they retreat into the sand again. Explain this behavior.** (The flatworms have green algae that live inside them. These algae need sunlight in order to create food for both themselves and the worms. When the tide goes out, the worms emerge so they can be exposed to direct sunlight.)

4. **When the sun and moon line up, how does this affect the tides on Earth?** (Since the sun reinforces the gravitational pull of the moon, the tug on the oceans is stronger. This creates a spring tide that's higher than usual.)

Complete the first activity and one other activity of your choice.

A Plan for All Seasons

Many of Earth's creatures change their behavior and/or location based on the change of season or the shift in tides. As you view this program, use this chart to help you organize the information you learn about the different animals in this program. Compare your notes with another classmate. Then, discuss an animal in your local habitat whose behavior changes with the seasons or tides.

ANIMAL	WINTER	SPRING	SUMMER	FALL	HIGH TIDE	LOW TIDE
CRANES						
SHOREBIRDS						
GREEN FLATWORMS						
HORSESHOE CRABS						
RED KNOTS AND ARCTIC TERNS						
GARTER SNAKES IN MANITOBA						

If your class has a sunny window, see if you can make a shadow clock. With tape, mark a large X on the window. Mark on the wall or floor where the shadow falls on an hourly basis. For a week or two, see how the patterns on the floor change.

To The Family

You are invited to view NATURE. As you watch the program, look for ways in which animal behavior is influenced by the rhythms caused by the sun and moon. After the program, you may also want to discuss how the balance between daylight and darkness varies where you live.

Midwinter festivals usually celebrate the shortest day of the year, the winter solstice. Use the library or the Internet to research why the early Christian Church chose the season of the winter solstice to celebrate Christmas.

These materials were made possible by Park Foundation, Canon U.S.A., Inc., Ford Motor Company, and TIAA-CREF.

OBJECTIVES

Students will:

✔ observe and analyze how natural forces, such as volcanoes, earthquakes, and floods influence the planet's climate and topography

✔ discuss how technological advances could have long-term effects on the earth's ecosystems

VOCABULARY

You may wish to introduce students to the vocabulary before viewing the program.

El Niño ("the boy child") noun: periods of time when unusually warm surface water along the western coast of South America causes extreme conditions around the globe, from floods to droughts

Gaia (pronounced "Guy-ah") noun: ancient Greek goddess of the earth

greenhouse effect noun: the warming of the earth's surface and atmosphere due to the earth absorbing more of the sun's radiation than usual

"Ring of Fire" noun: network of earthquakes and volcanoes that exist along tectonic plate boundaries in the Pacific Ocean

thermal spring noun: a pool of water that is heated by underground volcanic activity

SUGGESTED RESOURCES

For students who want to learn more about this topic, suggest the following:

Books

Edmonds, Alex. The Greenhouse Effect (Closer Look At). Brookfield, Conn.: Millbrook Press, 1997.

Glantz, Michael H. Currents of Change: El Niño's Impact on Climate and Society. New York: Cambridge University Press, 1996.

Kudlinski, Kathleen V. Earthquake!: A Story of Old San Francisco (Once Upon America). New York: Puffin, 1995.

Internet sites

Classroom Investigation - The Ring of Fire
http://suze.ucs.usl.edu/~dmy80s/menu01.02.a.html

Volcano World http://volcano.und.nodak.edu

U.S. G. S. Earthquake Information
http://quake.wr.usgs.gov

Mystery of the Maya
http://www.civilization.ca/membrs/civiliz/maya/mmi nteng.html

PROGRAM OVERVIEW

The ancient Greeks believed in an earth goddess named Gaia. Major geological changes, such as those caused by volcanoes, were considered Gaia's way of keeping order and balance on the planet. This program explores some of the dramatic ways that the earth's climate and topography have modified over millions of years. Through all the years, life in some form has survived. Some scientists speculate that life might play an important role in maintaining Earth's atmosphere, climate, and other environmental conditions.

For thousands of years, the human race has made monumental technological advances, from harnessing the power of fire to traveling to the moon. People have learned how to turn arid deserts into thriving cities, such as Las Vegas, by redirecting water supplies.

As "Living Dangerously" vividly illustrates, there are some forces of nature that humans cannot control. Earthquakes, such as those in San Francisco and Kobe, have caused thousands of deaths and billions of dollars in damage. Volcanoes, such as the 1997 eruption in Montserrat, hurled boiling clouds of ash into the sky, forcing the island people to evacuate.

Scientists assert that human advances may be having a deleterious effect on the planet. Power stations and automobile exhaust have pumped so much carbon dioxide and nitrous oxides into the atmosphere that the earth is heating up like a greenhouse. Many scientists are deeply concerned that this warming has also altered the earth's deep ocean currents.

THEME: "Living Dangerously" illustrates how Earth is in a constant state of change. These changes can have a dramatic impact on human life, which in turn influences Earth's delicate ecosystems.

BEFORE VIEWING THE PROGRAM

Introducing the Program

Ask students to brainstorm examples of major earthquakes and volcanoes that have occurred in the past 100 years. (If time permits, students could work in pairs to research some examples before discussing this information as a group.) As each example is mentioned, write the event on a small piece of colored paper and tape it onto a globe or map. If possible, try to get at least ten examples. Try to include several examples mentioned in this program: earthquakes in San Francisco and Kobe and volcanoes in Montserrat and Mt. Fuji.

Afterward, explain that while the precise timing of earthquakes and volcanoes is often difficult to predict, the locations are not. Earthquakes and volcanoes occur where tectonic plates meet. Earthquakes and volcanoes result when these plates collide, scrape, or pull apart. Many such events occur in the Pacific Ocean on what geologists call "the Ring of Fire."

Distribute the Student Worksheet (Naturalist's Guide)

Duplicate and distribute the Student Worksheet (Naturalist's Guide – opposite page) to students and preview it with them. As they watch the program, encourage students to observe how the "forces of the wild" change the shape and climate of the earth. Ask them to use the chart on the worksheet to help them record and organize their observations.

AFTER VIEWING THE PROGRAM

Encourage students to discuss the program and share their observations. The following questions may be used to spark discussion.

1. **How does the cyclical nature of ice ages support the idea that global warming may be occurring?** (Ice ages usually last for 100,000 years of cold followed by a 10,000 year warming period. We are at the end of that 10,000 year cycle, and the planet should be getting colder but instead is getting warmer.)

2. **How have human efforts to control the Mississippi River affected the river and nearby wildlife?** (By raising the riverbanks, humans have been able to curb some of the flooding. However, now the river flows much faster, which causes less sediment to be deposited along the shores. Without this sediment, coastal wetlands disappear, which has a disastrous impact on the local bird populations.)

3. **What are two ways that El Niño has affected Australia?** (By drying the environment in Australia, El Niño has caused terrible droughts and hundreds of brush fires.)

Complete the first activity and one other activity of your choice.

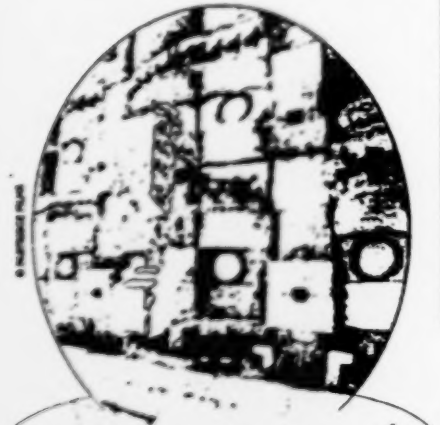
Earth vs. Nature

As you observe the program, you will see many examples of how natural forces change the climate and landscape of the earth. Use this chart as you make notes about your observations. After the program, compare your notes with your class and discuss what actions might be taken to lessen the impact of future natural disasters.

NATURAL DISASTERS	CHANGES TO EARTH	IMPACT ON PLANTS & ANIMALS (including humans)	WAYS WE COULD HAVE BEEN BETTER PREPARED
EARTHQUAKES IN SAN FRANCISCO (1906, 1989)			
EARTHQUAKE IN KOBE, JAPAN (1995)			
VOLCANO ERUPTION IN MONTSERRAT (1996, 1997)			
FLOODS IN THE MISSISSIPPI DELTA (1927, 1993)			
DROUGHT IN NORTHEAST AFRICA (MID 1980s-MID 1990s)			

To The Family

You are invited to view NATURE. As you watch the program, look for examples of how the earth's forces, such as earthquakes and volcanoes, affect plant and animal life. After the program, you may want to discuss some ways humans have developed to cope with these forces.



Mystery of the Maya

Based on ancient ruins, archaeologists have determined that a Mayan culture thrived in Mesoamerica for centuries. Research some of the great accomplishments of the Mayan people. Find out some theories that try to explain the mysterious decline of this ancient civilization.

These materials were made possible by Park Foundation, Canon U.S.A., Inc., Ford Motor Company, and TIAA-CREF.

People, People Everywhere

Earth's population is now about 5.7 billion, and is growing at the rate of about 100 million people a year. Use this information to create a graph that projects the earth's population in 10 years, 25 years, 50 years and 100 years. Present your graph to the class. Discuss how the earth will need to change in order to accommodate the growing population.

OBJECTIVES

Students will:

✔ observe and analyze the methods used to document natural phenomena on film

✔ examine how geologists in California prepare to measure future earthquakes along the San Andreas fault

✔ debate the merits and flaws of the Gaia hypothesis, which regards the planet Earth as a giant organism

VOCABULARY

You may wish to introduce students to the vocabulary before viewing the program.

bioluminescence noun: the light that some animals emit when certain chemicals in their bodies combine

fault noun: a fracture in the earth's crust; often the site of earthquakes and volcanoes

Gaia hypothesis noun: theory that suggests the planet Earth behaves as a giant, interconnected organism; "Gaia" was the ancient Greek goddess of the earth

imprinting noun: a rapid learning process that occurs early in the life of certain social animals and establishes a behavioral pattern, such as when a baby duckling bonds with its mother

marine biologist noun: a scientist who studies the behavior of organisms that live in the sea

SUGGESTED RESOURCES

For students who want to learn more about this topic, suggest the following:

Books

Arnosky, Jim. Bring 'Em Back Alive!: Capturing Wildlife on Home Video (A Guide for the Whole Family). Boston: Little, Brown, 1997.

Vogel, Carole G. Shock Waves Through Los Angeles: The Northridge Earthquake. Boston: Little, Brown, 1996.

Internet sites

Harbor Branch Oceanographic Institution
http://www.hboi.edu

Recent Earthquakes in California and Nevada
http://quake.wr.usgs.gov/recenteqs

The Parkfield Earthquake Prediction Experiment
http://www.slonet.org/vr/ipoes/oespark.html

Michigan Technological University Volcanoes Page
http://www.geo.mtu.edu/volcanoes/other.html

PROGRAM OVERVIEW

The Forces of the Wild series concludes with a behind-the-scenes presentation of the scientists and techniques involved in filming this dramatic footage. For example, while filming the eruptions of Kilauea in Hawaii, John Kjagaard developed a deep respect for the volatile volcano.

At the National Hurricane Center in Miami, meteorologists discuss how they informed the public as Hurricane Andrew swept across Florida in 1992. In another segment, geologists in Parkfield, California show the equipment they set up to measure the next major earthquake that hits the area. Since earthquakes are rarely caught on film, this program shows how an earthquake was simulated for this series.

Scientists are often humbled when they discover how much they still need to learn about the earth. During a visit to the Harbor Beach Oceanographic Institution, pilots and scientists describe their extraordinary investigations to the bottom of the oceans.

Some environmentalists believe that ignorance about how our actions impact on the earth could have dangerous implications. Oceanographer Sylvia Earle points out that our oceans are "dying" due to the selfish behavior of many humans. Such behavior could have long-term effects on the earth, as many of the systems on our planet are linked. The Gaia hypothesis, co-founded by James Lovelock, proposes that the planet Earth is essentially one giant superorganism.

THEME: "Playing with Fire" takes students behind the scenes of the Forces of the Wild series, and examines the special methods used to film and study natural disasters. In addition, new theories about the planet Earth as a giant superorganism are presented.

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BEFORE VIEWING THE PROGRAM

Introducing the Program

Review the natural events featured in programs 1 – 4 of Forces of the Wild. Encourage students to discuss some of the challenges faced by the people who wanted to photograph volcanoes, hurricanes, tornadoes, and earthquakes. In particular, discuss the challenges of trying to photograph natural disasters.

Distribute the Student Worksheet (Naturalist's Guide)

Duplicate and distribute the Student Worksheet (Naturalist's Guide – opposite page) to students and preview it with them. As they watch the program, ask students to pay particular attention to the dangers involved in filming natural disasters. Students can use the worksheet to record their observations.

AFTER VIEWING THE PROGRAM

Encourage students to discuss the program and share their observations. The following questions may be used to spark discussion.

1. **Why have geologists gone to Parkfield, California, to study earthquakes?** (Parkfield, California, is nicknamed the "earthquake capital of the world" because it is located directly above the San Andreas fault line. For this reason, earthquakes have occurred there regularly every 22 years, although the latest earthquake is long overdue.

2. **What are some of the dangers of filming volcanoes?** (If the wind changes quickly, the air temperature can jump to 500° F in a matter of seconds. Also, when the lava reacts with the sea, it creates clouds of hydrochloric acid, which can be deadly to breathe.)

3. **How did naturalist photographer Rose Buck use her knowledge of "imprinting" help her to film geese?** (By raising the geese soon after birth, Rose Buck was able to have the geese "imprint" on her, in other words, to see her as their parent figure. By doing so, the geese allowed her and her team to get close enough to them to capture their flight patterns.)

4. **Describe the methods the producers of this program used to create the illusion of an earthquake.** (They created a fake house, which they put on a pivot, so that people could forcefully pump a lever on each side, shaking the house. In addition, when the film was edited, it was presented in slow-motion to increase the drama and allow the viewer to watch the changes gradually.)

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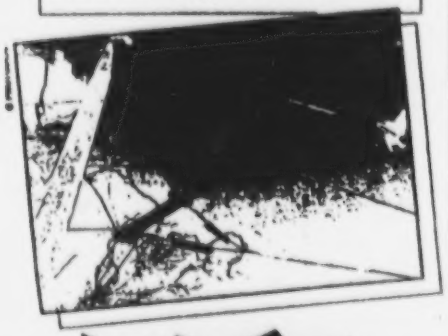
Complete the first activity and one other activity of your choice.

Filming the Forces

Photographing natural disasters can be fascinating work, but can also be very dangerous. As you watch this program, use the diagram to keep track of any of the hazards involved with trying to film these natural occurrences. Fill in the dangers of each.

VOLCANOES Dangers:	EARTHQUAKES Dangers:	HURRICANES Dangers:	TORNADOES Dangers:



If your school has access to a small video camera, create a short movie about how the "forces of the wild" affect your community. Alternately, you can use a still camera to create a series of photographs. Every day for a week, try to film some changes in the environment — from the changes in weather to close-up footage of local wildlife. Make sure to narrate what you see. When you're done, share your project with other classes in your school.

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Measuring and categorizing natural phenomena can sometimes be difficult. Nevertheless, scientists have developed methods and standards for recording the impact of earthquakes and hurricanes. The impact of earthquakes is measured on the Richter Scale; hurricanes are measured in terms of "Categories." (Hurricane Andrew became a "Category 4" hurricane when it hit the Bahamas in 1992). Read more about these two measurement scales and create a demonstration for your class that explains each scale.

To The Family

You are invited to view NATURE. As you watch the program, look for the different science careers that are presented, including wildlife photographer, geologist, and marine biologist. After the program, discuss how family members could learn more about these careers.

Almost every day, there is at least one earthquake on our planet. Many of these earthquakes are fairly weak, so they don't tend to get coverage in the newspaper or on TV. Use the Internet to research earthquake activity in California and Nevada. (One site to consider: http://quake.wr.usgs.gov/recenteqs) Turn your research into a weekly one-page newsletter for your class. If interested, you could also use the library, or call the U.S. Geological Society to find out about earthquakes in your area. As a supplemental activity, you could devise your own scale to measure volcanoes, then post your proposal on the Internet or a bulletin board at school.

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Video Ordering Information

Forces of the Wild is available on videocassette.

To order, write to WNET Video Distribution, P.O. Box 2284, South Burlington, Vermont 05407-2284. Please specify program title.

NATURE

1998 Spring Schedule
(check local listings)

PROGRAM	BROADCAST DATE
Forces of the Wild: In the Beginning	April 26
Forces of the Wild: Perpetual Motion	April 27
Forces of the Wild: Heavenly Partners	April 27
Forces of the Wild: Living Dangerously	April 27
Forces of the Wild: Playing with Fire	May 3
Grand Canyon	May 10
Eagles	May 17
The World of Penguins	May 24
Born to Run	May 31
Mask of the Mandrill	June 7
The Wild Side of New York	June 14
Bower Bird Blues	June 21
Monsoon	June 28

NATURE continues throughout the summer. Check local listings.

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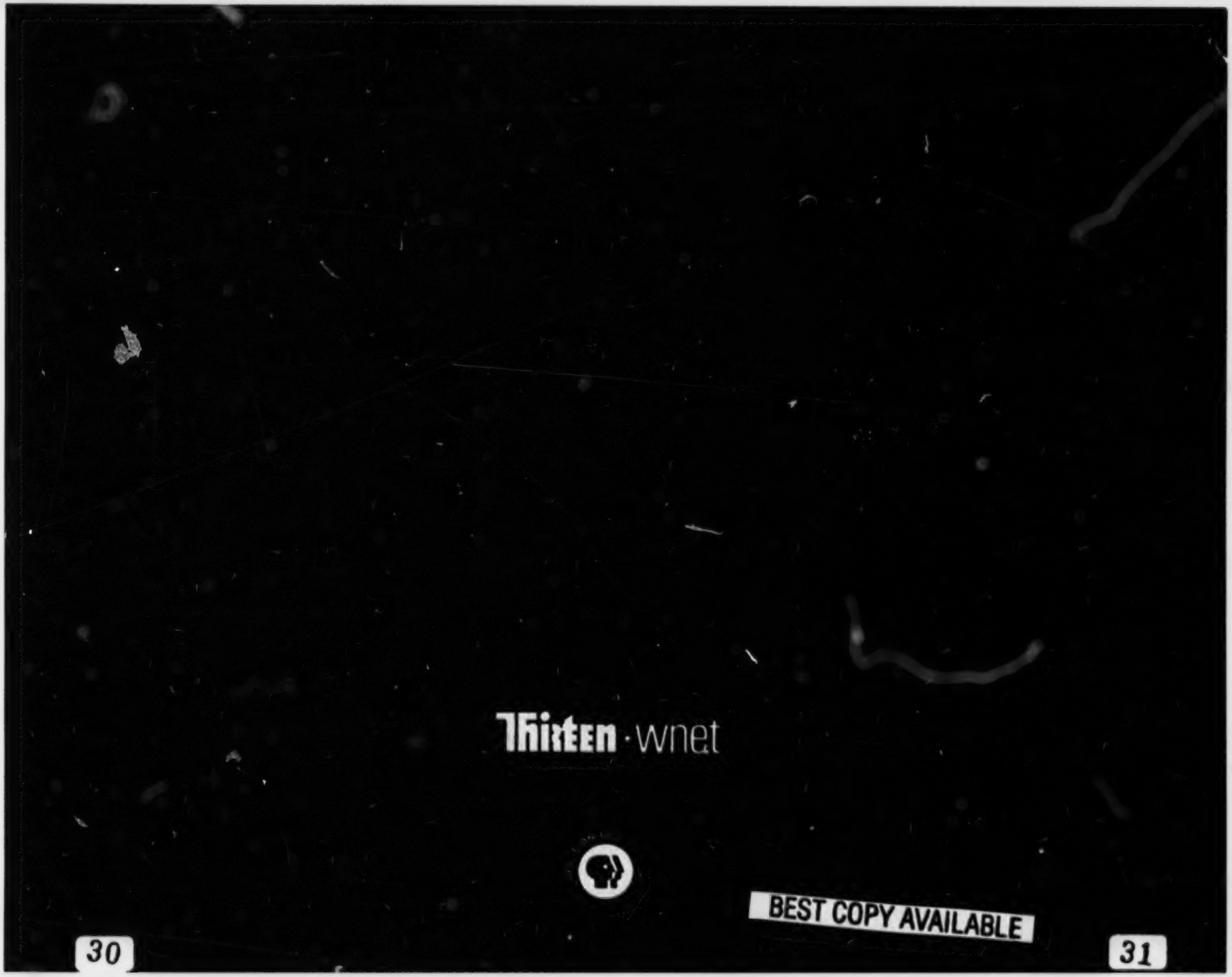

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